

# BIOGEOGRAPHY OF THE CICADAS OF THE ISLAND OF BACAN, MALUKU, INDONESIA, WITH DESCRIPTION OF *DICEROPYGA BACANENSIS* N. SP. (HOMOPTERA, CICADIDAE)

by

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## ABSTRACT

A collection of Bacan cicadas made by Mr and Mrs Rozendaal results in a biogeographic study of the cicadas of Bacan, which includes a description of *Diceropyga bacanensis* n. sp. and a generic re-allocation of *Gymnotympana subnotata* (Walker). The relationships and the distribution of the cicadas demonstrate: island endemism in Bacan, biogeographic coherence among the islands of Maluku Utara (= North Moluccas), a probable sister-group relationship between Maluku Utara and Maluku Selatan (= South Maluku) and a close biogeographic relationship between Maluku Utara and the Tjendrawasih area (= Vogelkop peninsula of New Guinea) with its adjacent islands.

## INTRODUCTION

During an ornithological survey of the island of Bacan (= Batjan; Batchian) in Maluku Utara (= North Moluccas), Indonesia in 1985, Mr Frank G. Rozendaal en Mrs Caroline Rozendaal-Kortekaas paid more than incidental attention to the cicada-fauna of the island. They brought together a small but interesting collection of cicadas, of which the present paper reports. Further consideration of the distribution of Bacan cicadas leads to some remarks on their biogeography in the light of our current study of areas of endemism in the Indo-Pacific.

### CICADAS COLLECTED BY MR AND MRS ROZENDAAL ON BACAN

The Rozendaal collection from Bacan comprises 28 specimens belonging to five species:

*Baeturia conviva* (Stål, 1861). Two specimens from primary forest on Gunung Bibinoi (50–100 m) and primary, riverine, forest on Gunung Sibela (850–1000 m) respectively. These specimens were included in De Boer's 1986 study of the *Baeturia conviva* group.

*Gymnotympana stridens* (Stål, 1861). One specimen from secondary growth along logging road at Wayaua. The specimen fits Stål's original description and Distant's figures (Distant, 1891: Pl. ix figs. 16, 16a–b).

*Gymnotympana innotabilis* (Walker, 1858) n. comb. (= *Cicada innotabilis*). Three specimens

from primary forest on Gn. Sibela. The specimens from Bacan are most probably conspecific to *innotabilis* on account of shape and marking of the head, and have the large opercula and other characters of the genus *Gymnotympana* Stål.

*Diceropyga junctivitta* (Walker, 1868). Seven specimens from logged forest, secondary growth and coconut and cacao groves along the Labuha-Amasing Kali (sea level) and eight specimens from similar habitats near Wayaua.

*Diceropyga bacanensis* n. sp. Two specimens from primary forest on Gn. Sibela of a species described as new in this paper.

### DISTRIBUTION OF BACAN CICADAS

The collection of Mr and Mrs Rozendaal stimulated further consideration of the distribution of the Bacan cicadas in the light of our current study of areas of endemism in the Indo-Pacific (Duffels, 1986). Up to now six species have been recorded from this island.

*Baeturia conviva* is endemic to Bacan and Obi (De Boer, 1986) and possibly the only representative on Bacan of the large and widely distributed genus *Baeturia* Stål (De Boer pers. comm.).

The genus *Gymnotympana* Stål is distributed in Maluku, New Guinea, and the D'Entrecasteaux Islands and Woodlark Island adjacent to the southeastern peninsula of New Guinea. A considerable collection of this genus was brought together from different institutions for a planned generic revi-

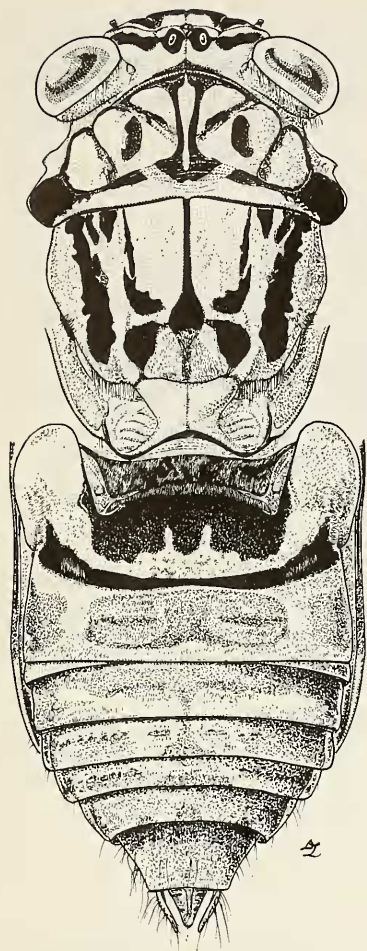


Fig. 1. *Diceropyga bacanensis*, paratype, Gn Sibela, 4.vii.1985.

sion. Considering publications by Walker (1868) and Distant (1892) and our unpublished data *G. stridens* occurs on Bacan, Morotai and Obi. *G. innotabilis* has been recorded from Bacan and Morotai (Metcalf, 1962; 1963: 392).

*Diceropyga junctivitta* is distributed throughout all islands of Maluku Utara including Talaud and the island of Waigeo near Tjendrawasih (= Vogelkop peninsula, New Guinea) (Duffels, 1977). *D. bacanensis* is an endemic of Bacan.

Another species, interesting in biogeographic respect, is *Rhadinopyga epiplatys*, which was re-

cently described from Bacan, Misoöl and Tjendrawasih (Duffels, 1985).

Table 1 gives the distribution of the mentioned species, which comprise the whole cicada-fauna of Bacan as far as presently known.

#### TAXONOMY

##### *Diceropyga bacanensis* n. sp. (figs. 1—5)

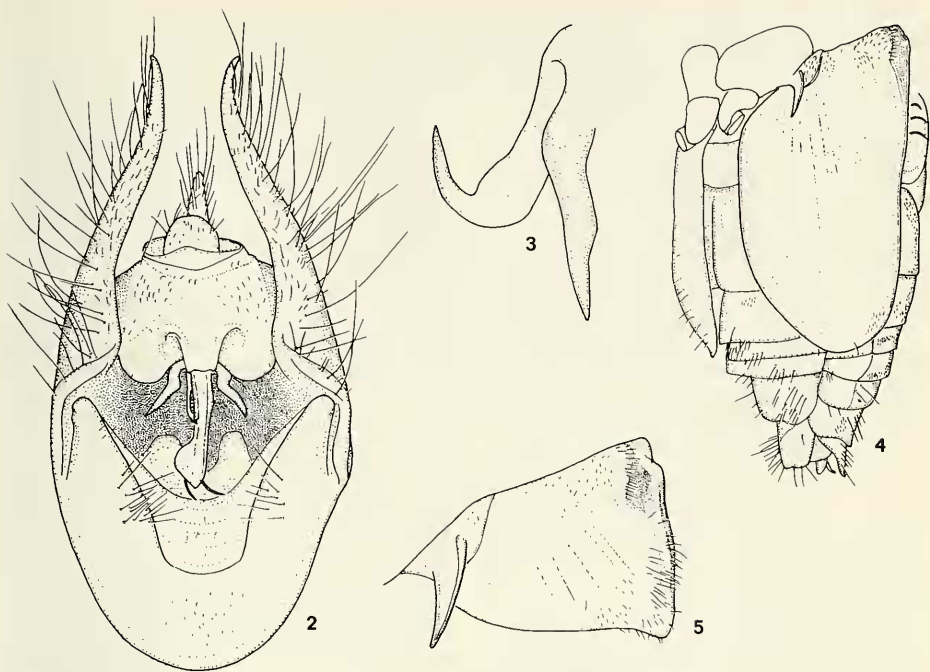
The two males of this new species from Gunung Sibela, Bacan were readily recognized as conspecific to the two female paralectotypes of *Dundubia subapicalis* (Walker, 1868) from Bacan, which could not be identified with certainty in connection with my revision of the genus *Diceropyga* (Duffels, 1977). At the time these two females were provisionally labelled *Diceropyga junctivitta* (Walker) (Duffels, 1977: 48). The two males from Gn. Sibela enable me now to describe this species as new to science. One further male and a female were found in the unidentified material of the British Museum (Nat. Hist.).

The new species is easily distinguished by its large body size (body length ♂: 29.7—31.6 mm, ♀: 28.9—29.0 mm), the distinct mesonotum marking and the dark marking on the lateral corner of the pronotum collar (fig. 1).

**Description.** — Ground colour of body brownish, marking black or brown.

Head dorsally with a transverse, strongly undulate, uninterrupted, black to dark brown line between eyes and trefoil-shaped black spot enclosing the three ocelli. Black spot around ocelli medially connected with fronto-clypeal suture. Uperside of vertex lobe with short, transverse, brown to black mark. Anterior part of supra-antennal plates black. Anterior part and ventral side of postclypeus with two paramedian series of 6—12 transverse, dark brown lines; medial ends of upper 3—7 lines of both these series medially connected to an arcuate line. A black to brown, medial, line of variable width runs along lower 2/3 of postclypeus underside and continues in most specimens along 3/4 of anteclypeus length. Genae unmarked. Mandibular plate black to brown near clypeal suture. Rostrum with black apex reaching beyond hind coxae.

Pronotum with two black, uninterrupted, central fasciae, which diverge to the anterior. Central fasciae widen strongly at anterior pronotum margin and continue in a black line along this margin; their posterior ends are distinctly widened. Two short dark brown stripes situated alongside, just



Figs. 2—5. *Diceropyga bacanensis*. 2, pygofer in ventral view, holotype; 3, right clasper in lateral view, holotype; 4, male abdomen with operculum in ventro-lateral view, paratype, Gn Sibela, 4.vii.1985; 5, female operculum in ventro-lateral view, paratype, Barchian, Wallace.

above and below, anterior oblique fissures; posterior oblique fissures brown. A pair of lanceolate, dark brown to black spots between both pairs of fissures. A very characteristic, broad, black fascia behind the eye widens proximally into a large, black mark covering nearly whole latero-proximal corner of pronotum collar. This marking continues mediad in a narrow black line in the ambient fissure.

Mesonotum with narrow, median fascia, widening at half its length — its greatest width is 5—6 times its anterior width — and narrowing again towards cruciform elevation. Paramedian fasciae run from anterior mesonotum margin along  $3/4$  the mesonotum length; distal ends of these fasciae recurved in medial direction. A pair of fairly large, black spots situated in front of anterior angles of cruciform elevation. The paratype from Gn. Sibela shows a rectangular black margin between apical thirds of both paramedian fasciae. Lateral fascia broad and irregular with two or more adjacent black marks near anterior mesonotum

margin. Hind margin of cruciform elevation black.

Legs. Fore femora with two parallel longitudinal lines on upperside, a proximally bifurcated line on anterior side, a longitudinal line on posterior side and a short line connecting spines along under-ridge. Middle femur with hairpin-shaped mark on anterior side. Hind femur with short distal streak on anterior side. Fore tibia darker brown than femur and with dark brown line on upperside. Apical  $2/5$  or half of middle tibia black-brown or with black-brown lines. Hind tibia light ochraceous, unmarked. Tarsi of fore and middle legs black, but pretarsus of middle leg light brown, pretarsus of fore leg sometimes light brown. Hind tarsi yellowish.

Tegmina and wings. Hyaline, basal cell yellow-brown. Basal half of venation ochraceous, apical venation ochraceous to greenish variegated with black. Tegmen infuscated at base of 2nd, 3rd, 5th and 7th apical areas, and with marginal spots at apices of longitudinal veins of apical areas.



Male. — Operculum (fig. 4) ochraceous, long, reaching anterior margin of abdominal segment 6 or even extending beyond anterior margin of segm. 7. Opercula of holotype somewhat broader than those of paratypes. Lateral margin straight of slightly outcurved (holotype) towards broadly rounded apex; a narrow black line extends from operculum base along  $3/4$  the length of lateral margin. Medial margins of both opercula nearly parallel in basal  $1/3$  and convex towards apex. Abdomen light ochraceous with dark brown dorsal marking. Segment 2 with broad transverse fascia between medial corners of timbal coverings; this fascia extends from anterior segment margin distad along  $3/4$  the segment's height. Segment 3 and 4 of holotype with median transverse marking as on segment 2 and a pair of lateral brown spots; these marks are fused to transverse fasciae in the paratypes. Segm. 5—8 dorsally brown. Pygofer (fig. 2) with long lateral processes reaching far beyond anal valves; apices of processes pointed and weakly curved. Clasper (fig. 3) with fairly long lateral spine and recurved, flat, medial hook. Aedeagus with a short subapical spine and two slender apical appendages.

Female. — Operculum (fig. 5) triangular, ochraceous, with narrow black-brown line along straight lateral margin; distal margin convex, latero-distal angle sharp. Abdomen with brownish dorsal marking; ventral side ochraceous. Segment 2 with brown median triangle, a pair of paramedian and a pair of lateral spots at anterior segment margin, extending distally to  $2/3$  the segment height. Segment 3 with similar marking as on segment 2, but median triangle and paramedian spots more or less fused. Segment 4—8 brownish dorsally. Segment 9 with pair of triangular brown markings extending from anterior margin along  $2/3$  the segment's length.

Measurements. Body length: ♂, 29.7—31.6 mm; ♀, 28.9—29.0 mm. Head width: ♂, 10.6—10.8 mm; ♀, 10.4—10.5 mm. Pronotum width: ♂, 11.4—11.6 mm; ♀, 11.5 mm. Mesonotum width: ♂, 10.1—10.5 mm; ♀, 9.5—10.2 mm. Tegmen length: ♂, 48.5—49.5 mm; ♀, 45 mm.

Holotype. — ♂, "Museum Leiden / BACAN (N. Moluccas) / Gn Sibela, trib. Ake Wayaua / 0° 43' S 127° 35' E, 840—1000 m / Primary forest, nat. clearing / 30 June 1985, F. G. Rozendaal" [printed label], "on mossy trunk, / c. 2 m high / prim. forest, 850 m. / 17.55 hrs FGR / sings at dusk / 30.vi.1985 / Bacan, Gn Sibela"

[handwritten label], Rijksmuseum van Natuurlijke Historie, Leiden (RMNH).

Paratypes. — Same printed label as holotype but date: 4 July 1985; handwritten label: 4.vii.1985, mistnet, prim. forest, 850+, Bacan, Gn Sibela, FGR, 1 ♂, RMNH; Batchian (Doherty) [Distant's handwriting], Distant Coll. 1911—383, 1 ♂, British Museum Nat. Hist. (BMNH); Batchian, Malay Archipelago, W. Doherty, 1903—31, 1 ♀, BMNH; Batch, 62/58, ?Paralectotype *Dundubia subapicalis* Walker, 1868 vid. J. P. Duffels 1974, *Diceropyga junctivitta* (Walk.)? ♀, det. J. P. Duffels, 1974, 1 ♀, BMNH; Bac, *Dundubia subapicalis*, Batchian, Wallace, Paralectotype *Dundubia subapicalis* Walker, 1868 vid. J. P. Duffels 1974, *Diceropyga junctivitta* (Walk.)? ♀, det. J. P. Duffels 1974, 1 ♀, National Museum Victoria, Melbourne.

#### Taxonomic position

*D. bacanensis* belongs to the *Diceropyga oblecta* group, which was erected (Duffels, 1977) for *D. oblecta* (Fabricius, 1803), *D. junctivitta* and *D. ochrothorax*. The *D. oblecta* group is characterized by a peculiar structural character: the clasper is attached to the underside of the uncus by means of a narrow stalk (Duffels, 1977: 30). This character was regarded plesiomorphous in comparison to the character state found in the *D. subapicalis* group (Duffels, 1977: fig. 264). However, I believe now that this feature of the *oblecta* group, which is unique in the subtribe Cosmopsaltriaria, must be regarded as a synapomorphy.

#### BIOGEOGRAPHY OF CICADAS OF MALUKU UTARA

Three monophyletic groups of cicadas endemic to Maluku and/or the Tjendrawasih area allow some further speculations on the historical biogeography of the cicadas in these areas. These groups are: the *Diceropyga oblecta* group, the genus *Rhadinopyga* Duffels and the *Baeturia conviva* group.

The *Diceropyga oblecta* group consists of four species endemic to Maluku (Duffels, 1977, this paper). The biogeographic coherence of the islands of Maluku Utara is demonstrated by the occurrence of three endemic species: *D. junctivitta* (also found in Waigeo), *D. bacanensis* and *D. ochrothorax* Duffels (endemic to Gebe Island), which are more closely related to each other than to the fourth species, *D. oblecta* (Fabricius), which is an endemic of Maluku Selatan and Sula Islands (distribution map in Duffels, 1977: fig. 36).

A close biogeographic relationship between Ma-

Table 1. Distribution of the cicadas of Bacan.

|                                 | Bacan | Obi | Other localities     |
|---------------------------------|-------|-----|----------------------|
| <i>Baeturia conviva</i>         | +     | +   |                      |
| <i>Gymnotympana stridens</i>    | +     | +   | Morotai              |
| <i>Gymnotympana innotabilis</i> | +     | —   | Morotai              |
| <i>Diceropyga junctivitta</i>   | +     | +   | Maluku Utara, Waigeo |
| <i>Diceropyga bacanensis</i>    | +     | —   |                      |
| <i>Rhadinopyga epiplatys</i>    | +     | —   | Misoöl, Tjendrawasih |

luku Utara and the Tjendrawasih area is found in the distribution of *D. junctivitta* and *Rhadinopyga epiplatys* (see table 1). Moreover, the monophyletic genus *Rhadinopyga* Duffels comprises four described and some undescribed species endemic to Bacan, Tjendrawasih and the adjacent islands Waigeo, Salawati and Misoöl (Duffels, 1986: fig. 7). De Boer (1986) concludes that the islands of Maluku Utara, Buru and the Tjendrawasih area including the Aru islands and Roon island in the Geelvink Bay form one area of endemism for the monophyletic *Baeturia conviva* group (distribution map in De Boer, 1986: fig. 28). The distribution of two sister-species of this group, *B. conviva* and *B. laureli* De Boer in Bacan-Obi and Halmahera respectively suggests again coherence of these Maluku Utara islands.

Regarding the relationships in Maluku can be remarked that two species from Maluku Selatan, *Diceropyga oblecta* of the *D. oblecta* group and *Baeturia schulzi* Schmidt of the *B. conviva* group, are probably sister-species of the three and two species from Maluku Utara.

Summarizing, our cicada-studies demonstrate (1) island endemism in Bacan, (2) biogeographic coherence among the islands of Maluku Utara, (3) a probable sister-group relationship between Maluku Utara and Maluku Selatan, (4) a close biogeographic relationship between Maluku Utara and the Tjendrawasih area with its adjacent islands.

The results of a study in progress of the cicadas of the *doryca* group of the genus *Cosmopsaltria* Stål from Maluku and Irian Jaya (Duffels, in press) will hopefully contribute to a further biogeographic analysis of the areas discussed.

A recent cladistic and biogeographic study of the Danaid butterflies of the genus *Idea* by Kitching, Vane-Wright & Ackery (1987) provides another example of biogeographic coherence of Maluku and the Tjendrawasih area. *Idea idea* (Linnaeus) is restricted to the Sula archipelago and

Maluku Selatan, while its sister-species, *I. durvillei* (Boisduval), is distributed throughout Maluku north of Obi and Misoöl into Irian Jaya and also occurs in the Kai and Aru archipelagos (Ackery & Vane-Wright, 1984). These two species form the sister-group of *Idea blanchardii* Marchal from Sulawesi and nearby islands.

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#### REFERENCES

- Ackery, P. R. & R. I. Vane-Wright, 1983. Milkweed butterflies: i—ix + 1—425. — British Museum (Natural History), London.
- Boer, A. J. de, 1986. The taxonomy and biogeography of the *conviva* group of the genus *Baeturia* Stål, 1866 (Homoptera, Tibicinidae). — *Beaufortia* 36: 167—182.
- Distant, W. L., 1891. A monograph of Oriental Cicadidae. Part 4: 73—96, pl. 7—9. — West, Newman & Co., London.
- Duffels, J. P., 1977. A revision of the genus *Diceropyga* Stål, 1870. (Homoptera, Cicadidae). — *Monografieën van de Nederlandse Entomologische Vereniging* 8: 1—227.
- Duffels, J. P., 1985. *Rhadinopyga* n. gen. from the "Vogelkop" of New Guinea and adjacent islands, a new genus of the subtribe *Cosmopsaltriaria* (Homoptera, Cicadoidea: Cicadidae). — *Bijdragen tot de Dierkunde*

- 55: 275—279.
- Duffels, J. P., 1986. Biogeography of Indo-Pacific Cicadoidea: a tentative recognition of areas of endemism. — *Cladistics* 2: 318—336.
- Duffels, J. P., in press. *Cosmopsaltria balmaberae* n. sp. endemic to Halmahera, Maluku, Indonesia (Homoptera, Cicadidae). The relationship of cicadas of Maluku Utara and Maluku Selatan. — *Bijdragen tot de Dierkunde* 58.
- Kitching, I. J., R. I. Vane-Wright & P. R. Ackery, 1987. The cladistics of Ideas (Lepidoptera, Danainae). — *Cladistics* 3: 14—34.
- Metcalf, Z. P., 1962. General catalogue of the Homoptera VIII. A bibliography of the Cicadoidea (Homoptera: Auchenorrhyncha): i—iv, 1—229. — North Carolina State College, Raleigh N.C.
- Metcalf, Z. P., 1963. General catalogue of the Homoptera VIII. Part 1 Cicadidae, Section 1 Tibiceninae: i—vii, 1—585. — North Carolina State College, Raleigh N.C.
- Stål, C., 1861. *Miscellanea hemipterologica*. — *Stettiner Entomologische Zeitung* 22: 129—153.
- Walker, F., 1868. Catalogue of the Homopterous Insects collected in the Indian Archipelago by Mr A. R. Wallace, with descriptions of new species. — *Journal of the Linnean Society, London (Zoology)* 10: 82—193.